EVALUATION, VERIFICATION, AND MEASUREMENT PLANS

Submitted To:

Roseville Electric

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TABLE OF CONTENTS

1 INTRODUCTION

The City of Roseville has a number of energy efficiency and renewable energy programs offered through its utility department (Roseville Electric). This report describes the Evaluation, Measurement, and Verification Plans for selected Roseville Electric (RE) energy efficiency incentive programs.

Two legislative bills (SB1037 and AB2021) were signed into law a year apart. SB1037 requires that the Publicly Owned Utilities (POUs), similar to the Investor Owned Utilities (IOUs), place cost effective, reliable, and feasible energy efficiency and demand reduction resources at the top of the loading order. They must now procure "negawatts" first. Additionally, SB1037 (signed September 29, 2005) requires an annual report that describes the programs, expenditures, expected energy savings, and actual energy savings.

Assembly Bill 2021, signed by the Governor a year later (September 29, 2006), reiterated the loading order and annual report stated in SB1037 as well as expanded on the annual report requirements. The expanded report must include investment funding, cost-effectiveness methodologies, and an independent evaluation that measures and verifies the energy efficiency savings and reductions in energy demand achieved by the energy efficiency and demand reduction programs. AB2021 additionally requires a report every three years that highlights cost-effective electrical and natural gas potential savings from energy efficiency and established annual targets for energy efficiency and demand reduction over ten years. The legislative reports require both an on-going assessment of what is occurring within the programs along with a comparison of how much possible savings are left within the POU service territory.

The goals of the EM&V effort at RE are to provide unbiased, objective, and independent program evaluations by giving:

- Useful recommendations and feedback to improve RE programs.
- Assessment of conservation program effectiveness.
- Assessment of the quality of the program data for impact evaluation purposes.
- Increased level of confidence in conservation program results through transparent protocols.

The first goal will be met through process evaluation and the latter three goals through impact evaluation of RE programs. The EM&V efforts will review the program impacts from 7/1/07 through 6/30/08 (FY 2007/08), and the process evaluation will focus on the current program offerings.

These EM&V draft plans were created based on a review of the current program offerings and discussions with RE staff regarding evaluation priorities. The remainder of this document will describe the recommended EM&V approaches for each targeted program.

2 GENERAL IMPACT EVALUATION METHODS AND DATA SOURCES

A useful construct for thinking about the range of efficiency measures offered by RE is the International Performance Measurement and Verification Protocol (IPMVP). Table 2-1 presents a listing of the IPMVP protocols, the nature of the performance characteristics of the measures to which M&V options typically apply, and an overview of the data requirements to support each option. Our approach to selecting M&V strategies will follow these guidelines.

Table 2-1: Overview of M&V Options

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
Option A: Engineering calculations based on spot or short-term measurements, and/or historical data. Deemed energy savings fall in this Option.	Constant performance	• Verified installation • Nameplate or stipulated performance parameters • Spot measurements • Run-time hour measurements
Option B: Engineering calculations using metered data.	Constant or variable performance	• Verified installation • Nameplate or stipulated performance parameters • End-use metered data
Option C: Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multi-variate regression analysis.	Variable performance	• Verified installation • Utility metered or end-use metered data • Engineering estimate of savings input to SAE model
Option D: Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering.	Variable performance	• Verified installation • Spot measurements, run-time hour monitoring, and/or end-use metering to prepare inputs to models • Utility billing records, end-use metering, or other indices to calibrate models

Many of the energy saving estimates used by RE in its planning and reporting are deemed saving values from the DEER database. These savings are used by the Northern California Power Authority (NCPA) members in the E3 benefit/cost calculator used for reporting to the California Energy Commission (CEC). For measures that utilize deemed energy savings estimates, Option A is the appropriate M&V option. The deemed saving estimates will be reviewed to insure correct values are used, but no field work involving metering or billing analysis will be needed. However, some form of installation verification will be needed; either on-site, by telephone, or through invoice reviews.

More complex measures, especially those installed under non-residential custom program, may need to employ some form of Option "B," although Option "A" may still be appropriate when deemed savings are available.

HVAC measures, especially for the non-residential sector, have the greatest level of *ex ante* energy savings estimate uncertainty, because they are based on savings estimates derived from building

simulation modeling with the building characteristics being an average across all vintages and building types. Because of this uncertainty, the methodology recommended for HVAC could be a multi-variate regression statistically adjusted engineering (SAE) model that uses pre and post program participation billing data along with a number of other potential explanatory variables. Among these other variables would be the *ex ante* estimates for the specific measures installed, as well as weather data and other relevant participant data that may be available from the program tracking database.

2.1 Metering Options (Option B)

Short term metering may also be the most appropriate M&V option. The goal of any measurements taken on equipment to determine energy savings is to accurately determine the usage. In order to do this, a metering period representative of the full range of equipment use must be selected. In many cases, a week is a good period since it covers a full cycle of a workweek and weekend, including both day and night operation. However, in cases of less consistent usage, longer periods must be selected. Two weeks can provide verification that is more reliable in case not all weeks show typical usage. Regardless, care must be taken to ensure that holidays or other unusual work periods are not included in the measurements. For lighting controls, a longer period, typically three weeks, is often necessary, because of the unpredictable nature of occupancy. Any system affected by weather can require a full year of data for truly reliable measurements, so billing data is often used instead of direct measurements. However, care must be taken in these cases to ensure that all systems included in the billing data are properly accounted for in variations.

Electric measurements are typically accomplished with either a single- or three-phase measurement, which directly measures power to equipment. Sometimes a spot-measurement is taken to determine power factor and then only current is measured over the following weeks. However, in this case, it is necessary to be sure that there will not be significant variations in power factor with load, or that they can be accounted for using equipment specifications.

Lighting: Lighting fixtures have well documented wattages and are rarely measured. Instead, savings numbers are calculated based on usage and standard wattages. Ballast checkers can be used to determine if older fixtures still use magnetic ballasts. Occupancy sensors have standard hour reductions based on area type (i.e., warehouses, offices, etc.), but if savings are expected to be higher, lighting loggers can be installed. This is typically done for a period of three weeks in thirteen locations to provide a statistically significant sample.

HVAC: Due to weather effects, this is typically based on billing data and modeled BIN (known weather) data. Logging is not often used, because strong seasonal variations in usage would require a full year of measurements without modeling.

Refrigeration: Equipment can be measured for a week or two using either three- or single-phase units, depending on how it is powered.

Water heaters and industrial ovens: Infrared temperature meters can be used to determine the rate of heat loss from the unit. Standard logging with either electric or gas flow meters is sometimes also done.

Motors (including pumps and fans): Nameplate data and spot measurements are typically used to determine usage by standard motors. If variable frequency drives (VFDs) are in use or being considered, a week or more of data is often logged with three- or single-phase meters since the variation in load is more significant. Motors without VFDs have fairly flat power usage as a function of loading. Often, a single spot measurement is taken to determine the power factor under the current conditions. If a motor drives a

load with significant variations, such as with a throttled pump or damped fan, it generally benefits from the addition of a VFD. Measurements can be taken directly of the throttle or damper to determine what percentage of time it is in use and how significantly it decreases the flow. Under conditions of significant throttling or damping, a VFD is usually cost effective. Pump or fan curves are used to estimate savings with a VFD. A week of logged electrical data pre- and post-installation is used to confirm savings in most cases.

Compressed air systems: Typically, three-phase electrical power measurements are taken over a period of a week and combined with information about systems using the air and manufacturers' data to determine the use and efficiency of the system. AirMaster+ is a software tool provided by the US Department of Energy that is often used in these calculations. Alternatively, spreadsheets can be used to manually calculate savings. In either case the manufacturer's specification include loading curves that shows energy use as a function of airflow and pressure. This information is combined with logged data on usage and any planned airflow reductions to estimate electrical usage after a retrofit. Airflow reductions can be the result of leak repair, equipment replacement, or simple pressure reductions for equipment. Electrical usage prior to the retrofit is simply calculated using logged data and the two values are compared.

Other equipment: Logging (measurements over a week or two) and spot measurements of power are often made on other equipment with significant usage.

2.2 Sample Size Consideration

The statistical validity of results is an important consideration in EM&V activities. Samples of populations are most often taken when performing evaluations. However, a survey sample is not meaningful without sample design considerations. A good sample is a miniature version of the population. It should represent the variability within the total population. For instance, if the population of measures to be evaluated within a program (with the program considered the universe) includes 30% lighting measures, 40% appliance measures, 10%VSDs, and 20% HVAC measures, then the sample population should have a similar distribution. Alternatively, each of these end-uses could represent a population (universe) to be sampled individually. In cases such as HVAC measures, the population could be made up of air conditioning, furnace, and building shell measures. Within the HVAC category, the sample should be drawn to insure representativeness among these diverse measures is maintained.

All samples contain errors. Although good sampling chooses to try to exemplify a target population, chance dictates that the two are unlikely to be identical. If one were to draw an infinite number of samples from a population, the statistics produced would describe the sample. Statistics like the mean and standard deviation would form a normal distribution around the population value. The sample means gather closer around the true population mean with larger samples and populations that are more homogeneous. The variation of the sample means around the true value is called the sampling error. The higher that one wants confidence in results and the smaller one wants the sampling error around the results, the larger the sample population. Evaluations try to balance the cost of performing surveys with the level of confidence one wants in results. Most utility evaluations try to achieve results with a confidence level of 90 or 95 percent with a confidence interval of either +/- 5% or +/- 10%. Some utility evaluations provide confidence levels as low as 80% with confidence intervals between +/- 20%. It is our recommendation that RE evaluation efforts seek to achieve confidence levels of 90% +/- 10%. Table 2-2 provides sample sizes for different populations (universes) and different confidence levels. As can be seen, the 95/5 confidence level requires significantly larger samples, especially at the larger population levels. The sample sizes for 90/10 are considerably lower than 95/5, but not significantly larger than 85/15 or 80/20.

Table 2-2: Sample Sizes by Population Size and Level of Confidence

	Level of Confidence and Confidence Interval			
Population	**95% +/- 5%**	**90% +/- 10%**	**85% +/- 15%**	**80% +/- 20%**
20	20	16	11	8
60	53	33	17	9
100	80	41	19	10
1000	278	64	23	11
5000	357	67	23	11

3 CURRENT PROGRAM OFFERINGS

Roseville began offering energy efficiency programs in the early 1980s. From 2001-07, these programs reduced peak demand by 11.2 megawatts and cumulative energy savings by over 86,000 megawatt-hours. Roseville's total expenditures for energy efficiency programs during fiscal year ending June 30, 2007 were $1,115,911.

Current Business and Residential Customer Programs

Energy Efficiency Program - Roseville offers comprehensive technical support and incentives to facilitate installation of incrementally higher-efficiency cooling and refrigeration equipment, envelope measures, appliances, lighting, and controls for business and residential customers.

Energy Audits - Free, on-site energy audits by Roseville personnel are available for both business and residential customers. Online audit tool kits are also available for residential customers.

Shade Tree Program - Provides complimentary shade trees for the properties of both residential and business customers to reduce air conditioning load. The program also provides educational information regarding the care of trees to help ensure energy savings.

New Construction Programs

New Construction Agreements - RE requires developers to commit to new construction development agreements that contain specific energy efficiency requirements, including increased efficiency requirements for air conditioners.

Residential New Construction Program - RE also provides incentives to builders to exceed the above agreements. The Preferred Homes energy efficiency and the BEST Homes energy efficiency and roof-top solar electric programs are popular among local builders.

The Preferred Homes are built with the following components, at a minimum:

- 15 SEER/12 EER AC Unit with TXV;
- An Electronically Commutated Motor;
- Minimum R38 attic insulation;
- Tested Tight Ducts, maximum 6% leakage; and
- Minimum 20% cooling savings better than 2005 Title 24 requirements.

The BEST Homes bring together integrated rooftop solar electric generation technology, high energy efficiency, water efficiency, and shade trees as a standard feature in homes. Through BEST Homes, RE is offering new home developers up to $8,600 in rebates for each participating dwelling unit (plus $30 per qualifying Shade Tree).

Business New Construction Program – This program provides assistance in bringing energy efficiency into the design and construction of the facility. The goal is to control peak load and reduce overall energy use. The program includes lighting, mechanical, envelope, or whole-building measures. RE's Business New Construction Design Incentives feature tiered incentive levels that encourage owners and builders to include measures that conserve energy during the project's design phase.

Municipal Facilities Programs

Municipal Facilities Upgrades - RE is continuing a ten-year plan to upgrade the efficiency of municipal facilities beyond code requirements during capital improvement, renovation and new construction projects, including upgrades to improve the operations and performance of electrical and mechanical systems.

- Lighting re-designs to reduce watts per square foot in city buildings and improve worker environment.
- HVAC upgrades to more efficient HVAC units.
- Use of properly selected and planted shade trees to reduce energy consumption.
- Thermally restrictive windows (dual pane) to reduce the heat gain in the building space.
- New construction design features on city buildings including: LEED certification, shade overhanging eves, and skylights to reduce lighting needs.

School Programs

- Assisted local schools with T-12 to T-8 and T-12 to T-5 retrofits.
- Replacement of incandescent or fluorescent exit signs with LED signs.
- Installation of programmable thermostats.
- Replace computer monitors with more efficient monitors.

4 SUMMARY OF FY 2007/2008 ESTIMATED SAVINGS FROM THE PROGRAM TRACKING DATABASE

The program tracking database is the primary source for the estimates of claimed DSM energy savings from the RE Energy Efficiency Programs. Summit Blue performed a preliminary review of this database in order to identify estimated program impacts and use the data to base the impact evaluation methodology recommended for each program. More detailed review will occur when actual impact evaluation efforts are made.

The savings are disaggregated by sector (residential versus non-residential) and by the measure categories as maintained in the database. Table 4-1 provides the information collected from the program tracking database for measures funded by demand side management (DSM) budgets for the residential sector. The number of projects, the estimated energy and peak demand savings, and the incentives provided are identified.

Table 4-1: Estimated Energy and Demand Impacts for FY 2007/2008 for the Residential Sector

	# of Rebates	Annual Reduction (kWh)	Summer Peak Reduction (kW)	kWh % of Total	kW % of Total	Demand Side Management Incentives Paid
HVAC-A/C	720	239,397	234	12.9%	29.0%	$275,600
Appliance	1,750	147,794	30	8.0%	3.7%	$88,424
New Con.	337	345,234	215	18.6%	26.7%	$168,500
Shade Trees	1,065	210,870	61.8	11.4%	7.7%	$88,778
Development Agreement	701	492,102	197.7	26.5%	24.5%	$0
LivingWise	6	330,898	0.0	17.8%	0.0%	$35,900
Efficiency	346	91,328	68	4.9%	8.4%	$34,438
Total	4,925	1,857,623	805	100.0%	100.0%	$691,640

According to the database, the largest programs in terms of energy savings are the new construction based Development Agreement Program with a share of 26%, the New Construction Program with a share of 19%, the LivingWise Program at 18%, and the HVAC – A/C Program with a share of 13% of claimed energy savings. Though LivingWise is tracked in the database as 18% of total energy savings, the savings are greatly reduced for reporting purposes. This will be discussed in greater detail later in this plan. For demand, the largest share of claimed demand reduction comes from the HVAC – A/C Program with 29% followed closely by the New Construction Program with 27% and the Development Agreement Program with 24%. The Shade Tree Program, though not the largest residential program in terms of energy impact, provides a significant 11% share of energy and 8% of demand claimed savings.

Figures 4-1 through 4-3 illustrate the data presented in Table 4-1. Figure 4-1 presents the shares by program for estimated energy reductions, Figure 4-2 for estimated summer peak reduction, and Figure 4-3 for the incentives paid. Reviewing the shares of energy savings versus summer peak reduction shows an expected consistency between the two.

Figure 4-1: Energy Impact Shares for FY 2007/2008 for the Residential Sector

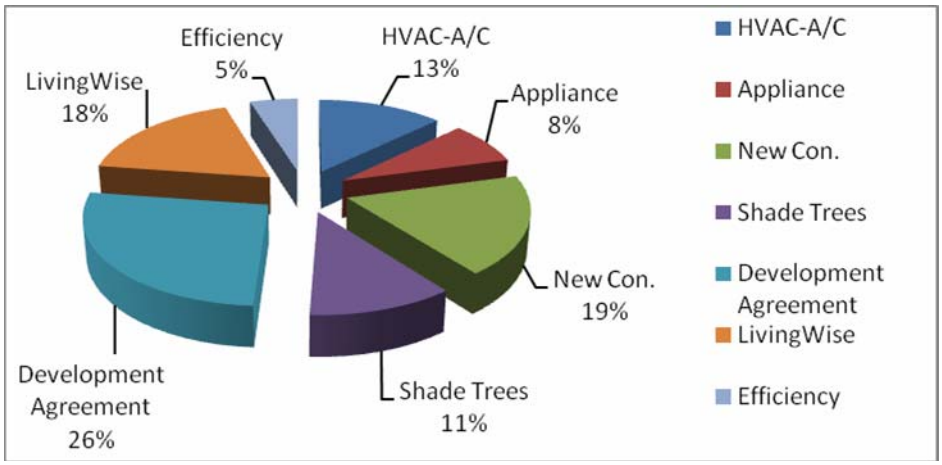


Figure 4-2: Summer Peak Reduction Shares for FY 2007/2008 for the Residential Sector

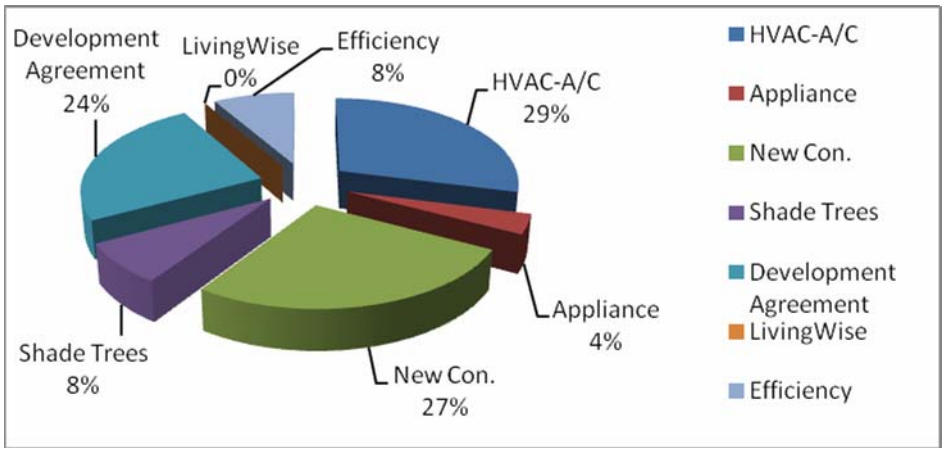


Figure 4-3: Incentives Paid Shares for FY 2007/2008 for the Residential Sector

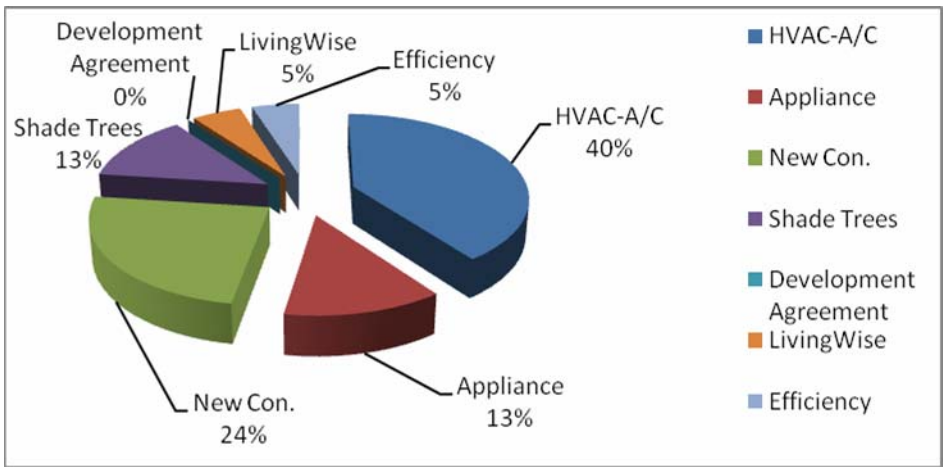


Table 4-2 provides the information collected from the program tracking database for measures funded by public benefits funds and other demand side funds for the non-residential sector. Compared to Table 4-1, the non-residential sector provides significantly greater levels of energy savings. The number of projects, the estimated energy and peak demand savings, and the incentives provided are identified in the table.

Table 4-2: Estimated Energy and Demand Impacts for FY 2007/2008 for the Non-Residential Sector

	# of Rebates	Annual Reduction (kWh)	Summer Peak Reduction (kW)	kWh % of Total	kW % of Total	Demand Side Management Incentives Paid
HVAC	4,821	341,445	41	4.2%	2.9%	$24,628
Custom	20	4,550,896	663	55.4%	46.7%	$366,413
New Con.	36	325,894	80	4.0%	5.6%	$21,370
Lights	21,186	2,994,251	637	36.5%	44.8%	$326,351
Total	26,063	8,212,486	1,422	100.0%	100.0%	$738,762

The greatest level of program impacts, both in terms of energy and demand savings, is from the Custom Rebate Program at 55% and 47%; respectively. Close behind the Custom Rebate Program in impact is the Lighting Program with a 36% share of energy savings and a 45% share of demand savings.

Figures 4-4 through 4-6 illustrate the data presented in Table 4-2. Figure 4-4 presents the shares by program for estimated energy reductions, Figure 4-5 for estimated summer peak reduction, and Figure 4-6 for the incentives paid. Reviewing the shares of energy savings versus summer peak reduction versus incentives provided shows for the most part an expected consistency among the three graphical representations.

Figure 4-4: Energy Impact Shares for FY 2007/2008 for the Non-Residential Sector

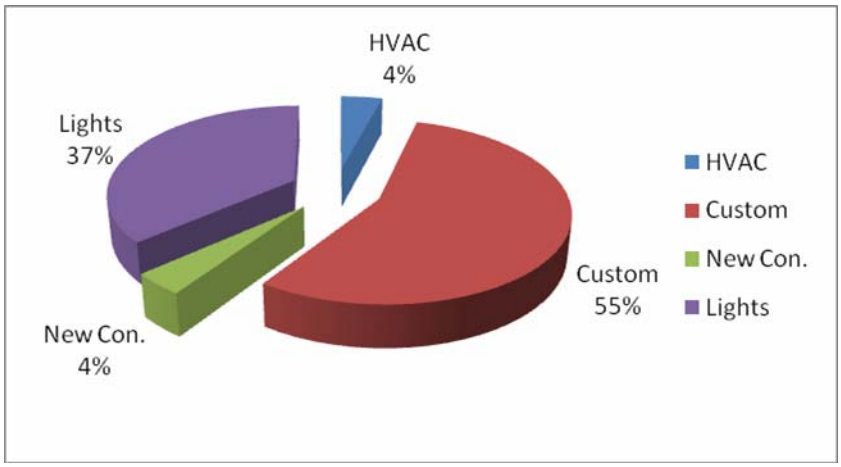


Figure 4-5: Summer Peak Reduction Shares for FY 2007/2008 for the Non-Residential Sector

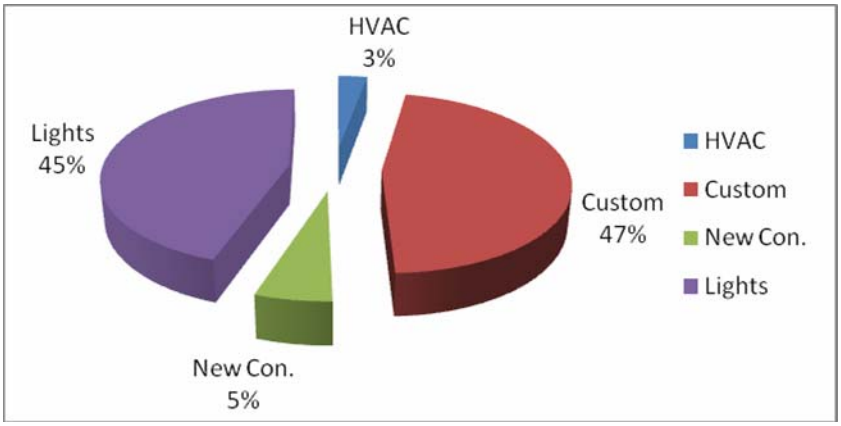
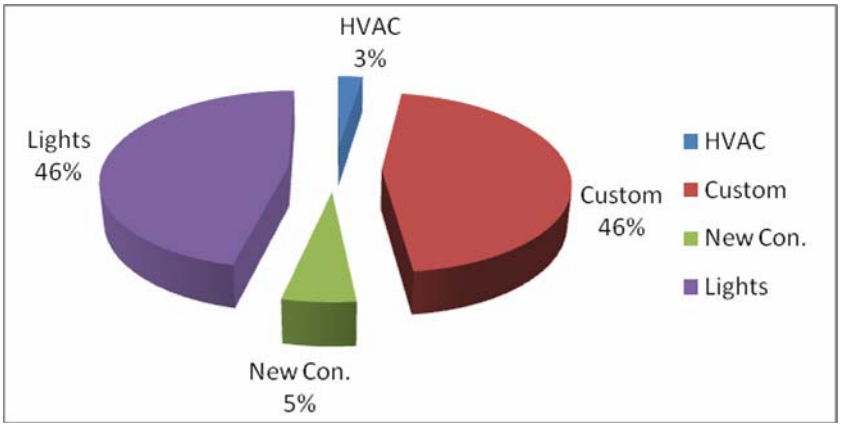


Figure 4-6: Incentives Paid Shares for FY 2007/2008 for the Non-Residential Sector



5 PRELIMINARY CROSS CUTTING PROCESS EVALUATION

5.1 Background and Objectives

The Summit Blue Team completed a preliminary process evaluation of the City of Roseville's efficiency programs, which consisted of the following activities:

- Reviewing the databases used to track Roseville's energy efficiency programs;
- Completing staff interviews with key program management;
- Assessing the measures currently included in Roseville's energy efficiency portfolio; and
- Identifying alternative measures for Roseville to consider offering to its customers.

5.2 Findings

This section summarizes the findings from a review of the current program offerings, tracking systems, and staff interviews. In summary, Roseville Electric staff should consider making the following changes to their programs:

- **Reassess the current residential energy efficiency measures receiving rebates**, specifically the rebates for clothes washers and dishwashers. Recent changes in retailer stocking levels and increased ENERGY STAR® specifications indicate the majority of new appliances already meet or exceed these standards. Roseville Electric may want to reallocate those rebate funds to target other efficiency measures. Appendix A provides a summary of the new ENERGY STAR standards, as well as a list of the new appliances that Roseville may want to consider including in future program years.

- **Make recommended changes and improvements to the database tracking system to streamline program reporting.**

- **Continue to market the residential and commercial programs through multiple channels as a way to increase awareness and contractor outreach**. Keep and possibly increase the amount of contractor rebates to encourage greater project completion, especially for commercial lighting projects.

5.3 Process Evaluation Data Included in the Current Program Tracking System

The following two figures illustrate the ways in which customers learned about the RE residential energy efficiency programs. These findings are based on data included in the database. However, it is important to note that this information was not tracked consistently across all programs, and therefore should be viewed as qualitative analysis rather than quantitative. In subsequent program years, RE should conduct surveys of its residential customers to corroborate these findings.

Figure 5-1: Ways Customers Learned about RE's Efficiency Programs

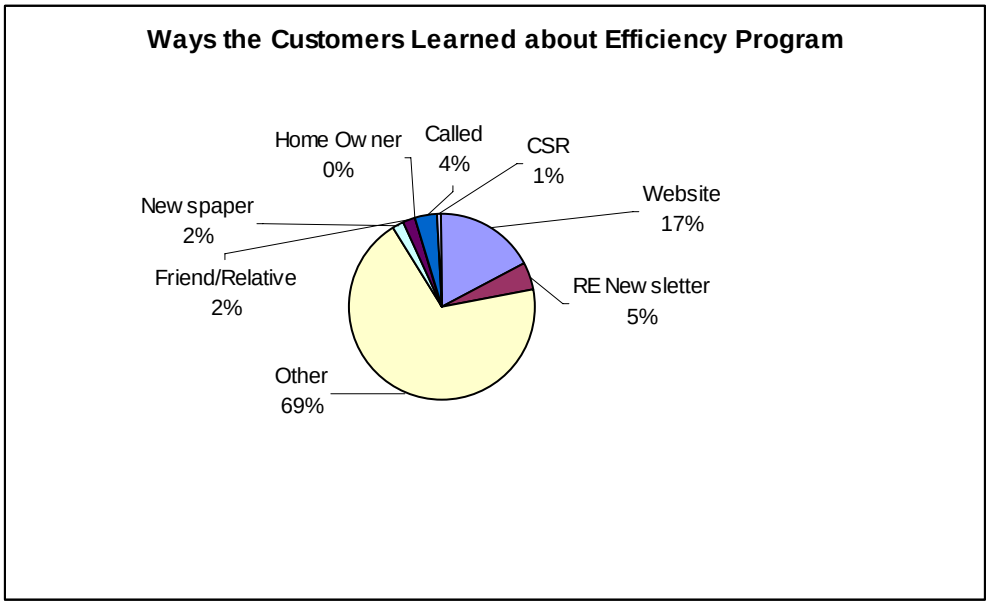
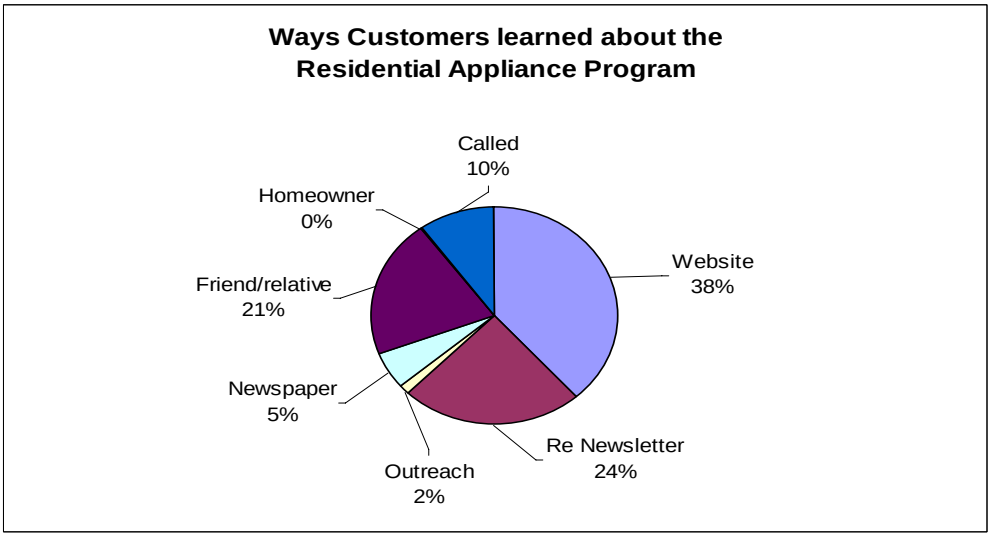


Figure 5-2: Ways Customers Learned about RE's Appliance Program



For non-residential programs, the database provided some valuable information regarding those projects that were rejected. These results are summarized in Table 5-1. Of particular note, there seems to be a significant level of fall-off in the lighting projects. Since most of the rejected projects appear to be small commercial, which is a contractor driven program, this fall-off may be due to the fact that contractors can make reservations without prior customer approval. This finding should be explored more fully in customer surveys with both lighting participants and non-participants in subsequent program years.

Table 5-1: Reasons Projects Were Rejected for Non-Residential Programs

Reasons	Custom	New Construction	HVAC	Lighting
Project Not Completed	1	2		88
Did not complete in time				
Other	1			
Reservation exceeds 45 day limit		10		5
Product does not meet criteria		7		2
Missing documentation		4		1
Customer decided not to proceed				7
Submitted after deadline				1
Total	2	23	0	104

5.4 Key Findings and Recommendations from Tracking Systems Review

- RE may want to consider modifying the code descriptions and coding numbering scheme so as to identify both the program and the specific measure in the database, such as (i.e., appliance, and then measure type, i.e., dishwasher, etc.) with possibly each program having a unique first digit.
- RE should code the efficiency level of the HVAC measures to provide a deeper level of analysis by labeling each measure with a separate numeric code to facilitate counts and data analysis.
- For the New Homes program, the variables “New Manufacturer” and “New Tonnage” appear twice, but not with always the same data. It is uncertain what these variables actually mean.
- The cubic feet for refrigerators and sizes for other appliances are not always provided. Additionally, the “Refrigerator Cubic Feet” variable has values for non-refrigerator measures.
- For the new construction database, it would be helpful if there were consistent descriptions of the measure type being installed.
- LivingWise is currently being tracked in the database with non-residential programs because it is a program tracked by school. However, it is tracking residential savings. Because of the difficulties with tracking this program in the databases, RE should consider tracking the LivingWise program separately.

5.5 Program Process Flow Diagrams

Figure 5-3 and Figure 5-4 illustrate the process flow for residential and non-residential programs starting with promotion through issuing the rebate and updating the program tracking database.

Figure 5-3: Process Flow Roseville's Residential Programs

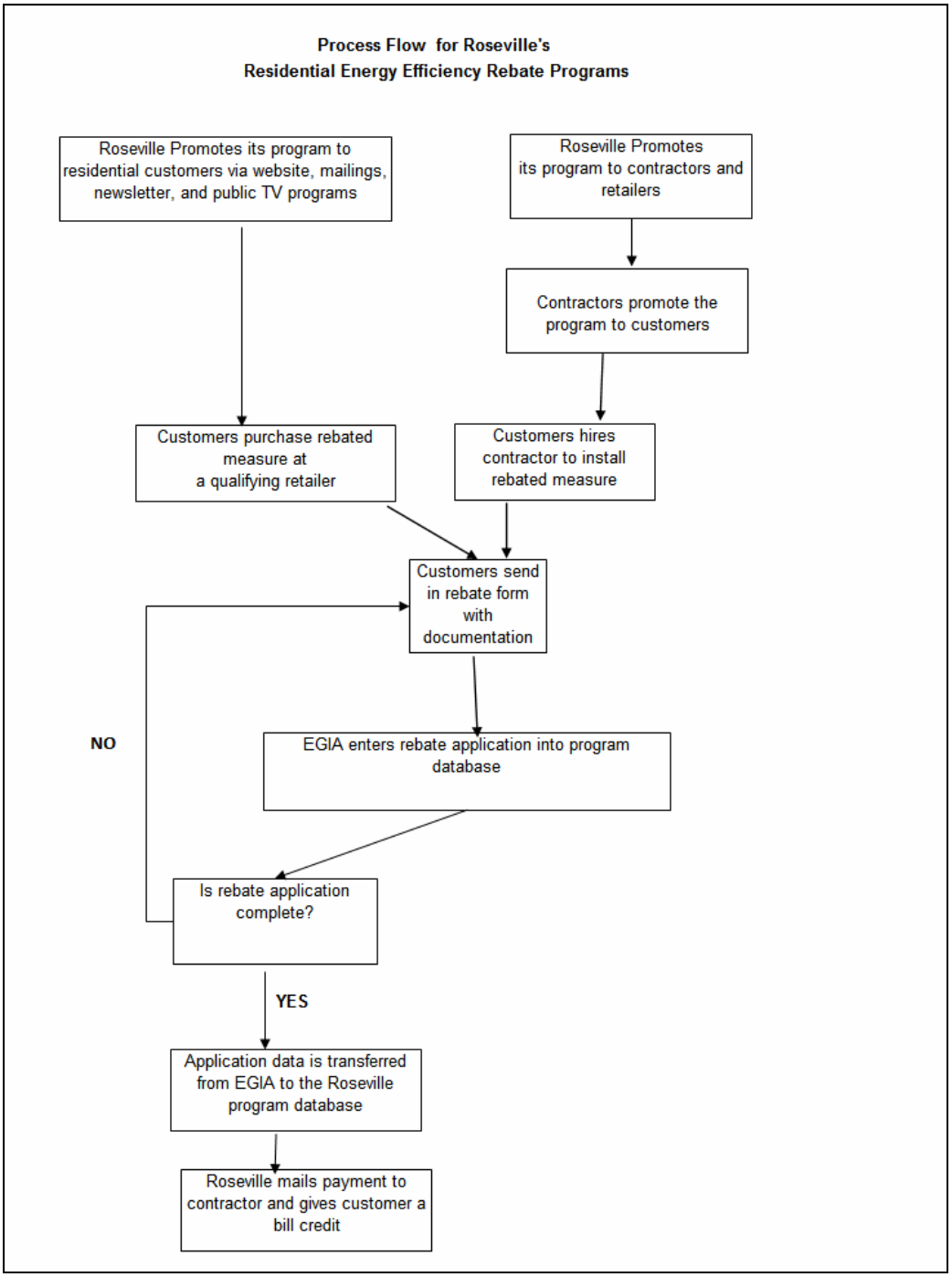
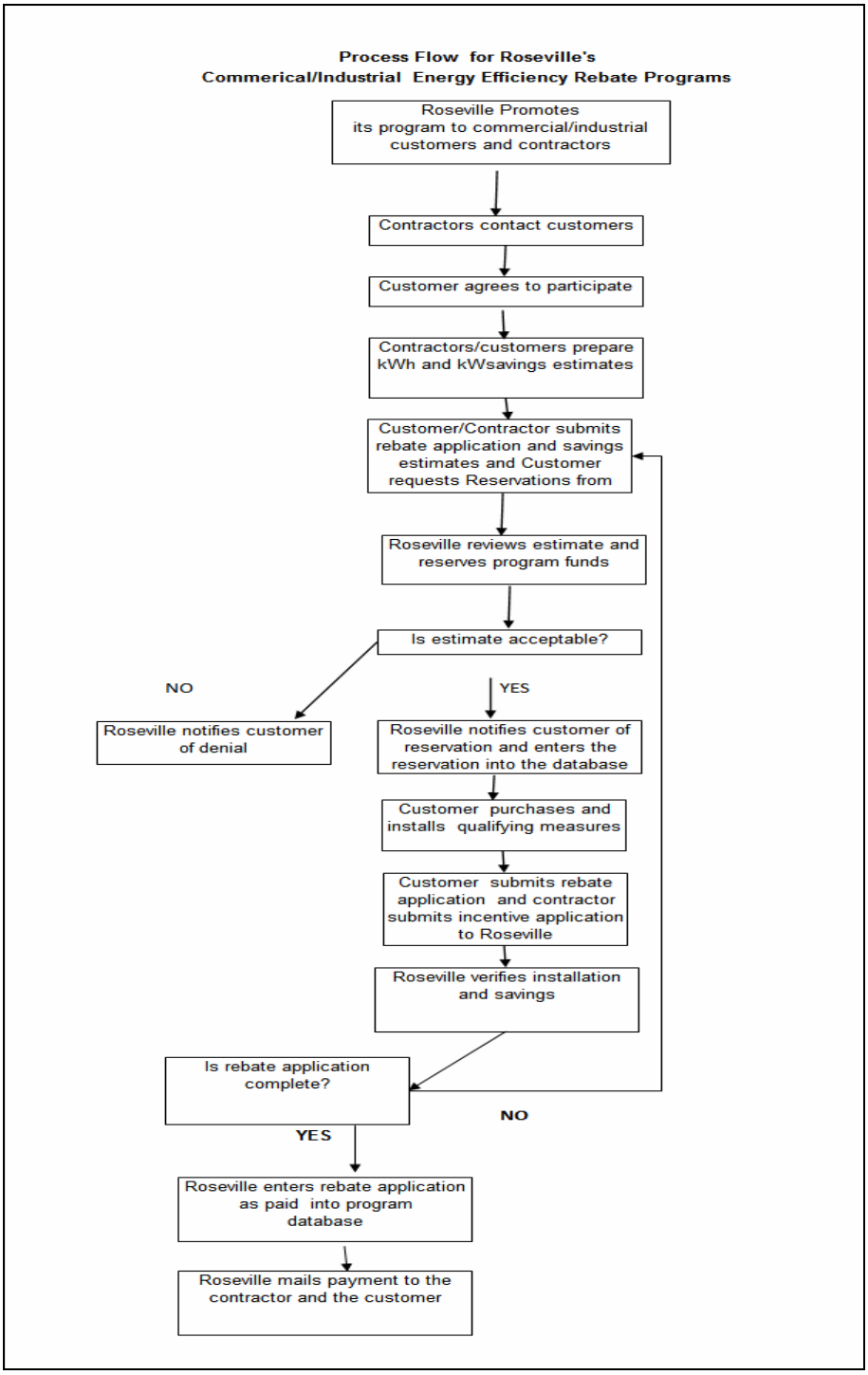


Figure 5-4: Process Flow- Commercial and Industrial Programs



5.6 Staff Interviews

The Summit Blue Team interviewed six staff members from the Roseville electric utility.

The staff interviews focused on the following topic areas:

- Program Background and Design;
- Program Implementation;
- Program Tracking and Administration;
- Program Results; and
- Areas for Improvement.

These staff members are involved in the implementation and administration of Roseville's residential and commercial energy efficiency programs. One staff member was instrumental in the initial design and deployment of these programs in the 1980s.The interviews included those staff that administer the energy efficiency programs, as well as account representatives assigned to Roseville's largest commercial and industrial customers.

Program Background

Roseville Electric began its efforts to develop a portfolio of energy efficiency programs in the early 1980s. The initial programs were funded through the public goods charges and the total budget was $500,000. Roseville patterned its programs after the energy efficiency programs offered by Pacific Gas & Electric (PG&E). Roseville also developed a program database for tracking the various residential and commercial programs.

The programs were designed to help both its residential and commercial customers reduce both peak demand as well as annual kilowatt hours. Roseville's energy efficiency programs focus on reducing overall electric usage and peak demand by targeting the largest end uses.

Program Marketing

The residential programs are promoted through bill inserts, customer newsletters, and advertisements in the city newsletter. Other promotional activities include:

- Collateral pieces and stand-alone materials at local nurseries to promote the Shade Tree Program
- Stories and news clips on the city-owned TV channel
- Workshops targeting maintenance and operations personnel for its commercial and industrial customers
- Targeted direct mail to commercial and industrial customers
- On-site visits and demonstrations of its online Energy Portfolio Manager

Program Results

The residential energy efficiency program staff reports that of the 150-200 HVAC contractors in Roseville and the surrounding areas, 50-60 are currently active in the program.

The Shade Tree Program has planted 14,000 trees since the start of the program in the mid 1990s.

The Small Commercial Lighting Program has exceeded staff expectations due to an increase in the rebate, which gives an additional $250 incentive to the contractor for completing the project.

The program staff reported positive feedback from both customers and contractors regarding these programs, especially now that the program incentives have been increased.

Program Tracking

The energy efficiency programs are tracked through the residential and commercial databases. This information is tracked for each program and includes the date installed, rebate amount, processing date, the vendor/contractor who installed the measure, and any appropriate expenses. Program information is captured on a simple application. The residential rebate applications are processed and input by a third-party, the Electric and Gas Industries Association (EGIA). Each week, EGIA downloads the application information into the Roseville database for processing and mailing out the rebates or posting a bill credit on the customers accounts.

Areas for Improvement

The Roseville staff indicated it is still difficult to recruit customers to participate in both the residential and commercial markets.

For the residential programs, the challenge is trying to encourage customers to make energy efficiency improvements when facing rising interest rates and less discretionary income.

For the commercial program, the staff identified the following challenges:

- "Split-incentives" that occur between the building owner versus the tenant.
- Encouraging participants in the "big box" stores to modify their existing building plans and incorporate energy efficiency improvements.
- Convincing customers to install more than one energy efficiency measure.
- Encouraging customers to replace rather than repair equipment.
- There is a constant rotation of lighting contractors that operate in both the Sacramento Municipal Utility District (SMUD) and Roseville Electric service areas.

5.7 Recommended Program Changes

This process review identified a number of areas for Roseville staff to consider regarding program modifications for its residential and commercial/industrial programs. Roseville staff should consider making program modifications to the residential programs to ensure that all residential appliances are now meeting the new ENERGY STAR standards that went into effect in 2007. Appendix A provides a summary of those new standards for all current and proposed measures in RE's residential program portfolio.

These program additions include the following:

1. *Roseville should consider adding a $25 rebate for ENERGY STAR Digital-to-Analog Converter Boxes.* Beginning February 17, 2009, the U.S. will shift to digital-only television broadcasts. As of this date, consumers with analog televisions, who do not subscribe to cable or satellite services and rely solely on over-the-air broadcasts for their TV-viewing will need a digital-to-analog converter box, or DTA, in order to continue receiving television broadcasts. The digital-to-analog (DTA) converter box is a device that converts digital television broadcast signals to analog signals. These boxes are currently being sold by a variety of retailers. These boxes are expected to cost between $40 and $70. The ENERGY STAR models consume no more than 8 watts in On Mode and 1 watt in Sleep Mode according to the Environmental Protection Agency (EPA). The product specifications are available on the following website: www.energystar.gov
2. *Roseville should consider providing a $25 rebate to encourage the purchase of ENERGY STAR television, DVDs, and related equipment.* ENERGY STAR qualified TVs use about 30% less energy than standard units. ENERGY STAR models are available on a range of TVs including standard TVs, to HD-ready TVs, and large flat-screen plasma TVs. The product criteria are provided in Appendix A.
3. *Roseville should consider developing a rebate program for residential water heaters.* Even though water heaters are still not under ENERGY STAR guidelines, there are several manufactures that make highly energy efficient electric tank water heaters. These manufacturers also offer special utility-oriented programs and include options to both rent or buy electric water heaters. These manufacturers include American Water Heater Rentals and Marathon Water Heaters.

Roseville should also consider making the following changes for is commercial programs:

- Develop brief (1-2 page) case studies and customer "testimonials" that showcase the savings that has been achieved from past program participants.
- Invite "key account" customers to specialized workshops that showcase energy efficient technologies such as "Advances in Lighting," "Advances in HVAC/Chillers," and "Advances in Motors."
- Develop marketing materials that specifically emphasize the benefits of early replacement for energy efficient technologies, including motors and lighting change outs. Provide this information to customers in emails, through targeted direct mailings, and at local contractors and trade association meetings.

6 RESIDENTIAL PROGRAM IMPACT EVALUATION PLANS

Seven residential program areas are tracked by RE's program databases. Table 6-1 provides the information collected from the program tracking databases for measures funded by public benefits and other demand side program funds for the residential sector. It is a duplication of Table 4-1. As shown in Figures 4-1 and Figure 4-2, the Development Agreement Program, the New Construction Program, and the HVAC – A/C program are similar in size and importance. The Shade Tree Program also provides significant shares of claimed savings as well. Of note is that the Development Agreement Program involves no incentive cost. The HVAC – A/C Program and the New Construction Program have the most incentives paid followed distantly in third by the Shade Tree Program.

Table 6-1: Estimated Energy and Demand Impacts for FY 2007/2008 for the Residential Sector

	# of Rebates	Annual Reduction (kWh)	Summer Peak Reduction (kW)	kWh % of Total	kW % of Total	Demand Side Management Incentives Paid
HVAC-A/C	720	239,397	234	12.9%	29.0%	$275,600
Appliance	1,750	147,794	30	8.0%	3.7%	$88,424
New Con.	337	345,234	215	18.6%	26.7%	$168,500
Shade Trees	1,065	210,870	61.8	11.4%	7.7%	$88,778
Development Agreement	701	492,102	197.7	26.5%	24.5%	$0
LivingWise	6	330,898	0.0	17.8%	0.0%	$35,900
Efficiency	346	91,328	68	4.9%	8.4%	$34,438
Total	4,925	1,857,623	805	100.0%	100.0%	$691,640

Impact evaluation efforts for FY 2007/2008 program results do not need to cover all programs. They should cover the programs of importance in terms of both energy impact and incentive paid, and the programs that have the most uncertainty. Based on these facts, it is the recommendation of the Summit Blue Team that impact evaluations be prioritized as follows:

- New Construction (priority 1)
- HVAC (priority 1)
- Shade Trees (priority 2)
- LivingWise (priority 2)
- Development Agreement (priority 3)
- Appliances (priority 3)
- Efficiency measures (priority 3)

For FY 2007/08, it is recommended that the priority 1 and priority 2 programs receive an impact evaluation. The reason the Shade Tree Program is included is because of uncertainty within the Summit Blue team that all the planted trees from five years ago survived. The priority 3 programs can wait until another fiscal year.

6.1 Residential New Construction

The Preferred Homes and the BEST Homes programs each are designed to improve the efficiency of newly constructed homes beyond Title 24 minimum levels. The BEST Homes program also includes integration of rooftop solar PV into the new home construction.

In reviewing the program tracking system, it appears that most of the measures implemented are high efficiency air conditioning units. Many rooftop PV systems have also been installed, but are tracked separately. Renewable energy systems, such as rooftop PV, do not need to be evaluated under this current effort.

In our preliminary review of the savings estimates, it appears that deemed energy savings per ton is used. Table 6-2 identifies the range and average of the A/C units that received an incentive payment.

Table 6-2: Characteristics of the New Construction Program A/C Units

	A/C Tons	SEER	EER
Min	1.5	13	11
Max	5	15.5	13
Average	3.9	14.9	11.9
Ave kWh Savings/ton	1,031		
Ave kW Savings/ton	0.64		

A more detailed assessment of these energy impact estimates needs to be made. It is known that these New Construction Programs include savings beyond what is achieved with higher SEER/EER units, but it is uncertain what these additional activities are and what their assumed impacts are.

Impact evaluation of HVAC measures generally are performed either through reviewing deemed energy savings assumptions and calculations or through utility billing data analysis. However, since these are new construction homes, the billing analysis approach cannot be taken and instead, a review of the deemed measure energy savings assumptions and calculations is recommended. Performing such a review will reveal if the average savings per ton highlighted in Table 6-2 are accurate and reasonable and what assumptions are included in these estimates.

In addition to the review of deemed energy savings assumptions and calculations, verification of installation needs to be performed. There are two acceptable methods for accomplishing this. The first is on-site verification of a sample of installations. The second is a review of the documentation of installation collected and maintained by RE. This form of paper verification is to assure that invoice data has been collected and stored with the assumption that the actual invoice provides sufficient documentation of installation.

Summit Blue recommends that paper verification be performed. If the paper verification finds that insufficient documentation has been maintained by RE, then an on-site verification will be needed.

Summit Blue recommends drawing a sample of sufficient size to achieve results with a confidence level of 90 percent with a confidence interval of +/- 10%. About 337 sites were identified as receiving a public benefits incentive for this program. To meet the statistical confidence of 90% +/- 10% will require a sample draw of 57 participants. These 57 participant sites will be drawn at random from the database. The assumptions for deemed energy savings will be reviewed and the paper verification performed.

6.2 Residential HVAC

Under the residential HVAC Program, incentives are provided by RE for installation of energy efficient A/C and heat pump units in existing homes. The High Efficiency Air Conditioner and Heat Pump rebate levels are provided in Table 6-3.

Table 6-3: Residential HVAC Incentives

	Split Systems			Package Systems			
	SEER	EER	HSPF	SEER	EER	HSPF	Rebate
AC w/TXV	14.0	12.0		14.0	11.0		$550/unit
AC w/TXV	15.0	12.5		14.0	12.0		$750/unit
Heat Pump			8.5			8.2	$200/unit

In our preliminary review of the savings estimates, it appears that deemed energy savings per ton is used. Table 6-4 identifies the range and average of the A/C units that received an incentive payment. The average savings per ton appear to coincide with using the Title 24 base of a SEER 13.0 A/C unit.

Table 6-4: Characteristics of the HVAC Program A/C Units

	A/C Tons	SEER	EER
Min	2	14	11
Max	5	16	12.5
Average	3.5	14.5	12.2
Ave kWh Savings/ton	192		
Ave kW Savings/ton	0.19		

As indicated under the New Construction Program, impact evaluation of HVAC measures generally are performed either through reviewing deemed energy savings assumptions and calculations or through utility billing data analysis. Since both pre and post billing histories are likely available, either of these techniques could be used. However, a review of the deemed measure energy savings assumptions and calculations is an acceptable methodology and much less costly to perform than a billing analysis and is therefore recommended.

In addition to the review of deemed energy savings assumptions and calculations, verification of installation needs to be performed. There are two acceptable methods for accomplishing this. The first is on-site verification of a sample of installations. The second is a review of the documentation of installation collected and maintained by RE. This form of paper verification is to assure that invoice data has been collected and stored with the assumption that the actual invoice provides sufficient documentation of installation.

Summit Blue recommends that paper verification be performed. If the paper verification finds that insufficient documentation has been maintained by RE, then an on-site verification will be needed.

Summit Blue recommends drawing a sample of sufficient size to achieve results with a confidence level of 90 percent with a confidence interval of +/- 10%. About 350 sites were identified as receiving a public benefits incentive for this program. To meet the statistical confidence of 90% +/- 10% will require a sample draw of 57 participants. These 57 participant sites will be drawn at random from the database. The assumptions for deemed energy savings will be reviewed and the paper verification performed.

6.3 LivingWise

The LivingWise program is designed for implementation through elementary and middle school presentations. The presentations are designed to educate the students and each student receives a package of energy efficiency measures to install in their family's home. The measure kit includes:

- CFL

- Thermometer
- Filtertone Alarm
- EL nightlight
- Showerhead
- Faucet aerator
- Other non-energy items

The estimates of program impacts are provided by the program implementer, Resource Action Programs. They base their estimates on the number of kits distributed and a survey of those receiving the kits. RE has decided not to report the savings that are provided by the implementer. Instead, they take the savings provided and significantly reduce them based on their knowledge of the knowledge of their customers. For instance, this program reports considerable energy savings from water heating. However, RE know that the majority of the water heating is gas so they do not count the water heating savings when reporting their savings. Each of the elements of this program are assessed by RE in a similar manner.

The LivingWise program is in essence an educational program with an impact element to it. Each of the six projects under the program use identical methodology. An evaluation of this program was completed and submitted by the program implementer Resource Action Programs. However, even though the provided savings are not used in reporting, impact evaluations need independent verification. It is recommended that the evaluation report and all supporting methodologies and assumptions, be reviewed by Summit Blue. Since the methodology is the same across projects, each of the six will be reviewed. It is uncertain what form of documentation exists to help verify installation (outside of the survey performed) but it is not recommended that an on-site verification effort be made.

6.4 Shade Tree Program

Savings for the Shade Tree program are relatively straight forward and are based on deemed energy savings estimates per tree. The deemed savings do not appear to directly take into account the location of the tree in relationship to the building being shaded. However, it is assumed that the deemed value is an average of multiple tree locations. The methodology for claiming savings appropriately allows time for the tree to grow and provide shade. Savings begin to be claimed five years after planting.

Option A of the IPMVP M&V Options identified in Table 2-1 is recommended to be followed. The general deemed savings methodology will be reviewed, but the most important aspect will be the on-site verification. This will be performed through a drive by of the building and a cataloging of how many trees exist and their relative location to the building.

Summit Blue recommends drawing a sample of sufficient size to achieve results with a confidence level of 90 percent with a confidence interval of +/- 10%. The database indicates that 1,065 trees were planted under the program five years ago, though it is uncertain how many unique sites these 1,065 trees represent. Assuming that the sites have on average two trees planted, there would be about 500 unique sites. To meet the statistical confidence of 90% +/-

10% will require a sample draw of 60 sites. These 60 sites will be drawn at random from the database after sorting the trees into unique addresses.

6.5 Lower Priority Residential Appliance and Efficiency Measure Programs

The Summit Blue Team does not recommend that impact evaluations be performed in this fiscal year for these lower priority programs. Whether impact evaluations should be held in the future for these measures depends on whether they become a more important part of the energy savings portfolio. If such an evaluation were to take place, it is recommended that the simple Option A of the IPMVP M&V Options be followed for most of the measures. A review of deemed savings, which appear to be what are used in the program tracking database, could be made on the energy savings estimates. Verification would be either through a paper review of invoices on file or a telephone survey of a sample of participants.

7 NON-RESIDENTIAL PROGRAM IMPACT EVALUATION PLANS

Four non-residential program areas are tracked by RE's program databases. Table 7-1 provides the information collected from the program tracking database for measures funded by public benefits funds for the non-residential sector. It is a duplication of Table 4-2.

Table 7-1: Estimated Energy and Demand Impacts for FY 2007/2008 for the Non-Residential Sector

	# of Rebates	Annual Reduction (kWh)	Summer Peak Reduction (kW)	kWh % of Total	kW % of Total	Demand Side Management Incentives Paid
HVAC	4,821	341,445	41	4.2%	2.9%	$24,628
Custom	20	4,550,896	663	55.4%	46.7%	$366,413
New Con.	36	325,894	80	4.0%	5.6%	$21,370
Lights	21,186	2,994,251	637	36.5%	44.8%	$326,351
Total	26,063	8,212,486	1,422	100.0%	100.0%	$738,762

The greatest level of program impacts, both in terms of energy and demand savings, is from the Custom Rebate Program, followed closely by the Lighting Program. The HVAC and New Construction Programs combined account for less than 10% of either the energy or demand savings.

Impact evaluation efforts for FY 2007/2008 program results do not need to cover all programs. They should cover the programs of importance in terms of energy impact and the programs that have the most uncertainty. Based on these facts, it is the recommendation of the Summit Blue Team that impact evaluations be prioritized as follows:

- Custom (priority 1)
- Lighting (priority 2)
- New Construction (priority 3)
- HVAC (priority 3)

For FY 2007/08, it is recommended that the priority 1 Custom Program receive an impact evaluation. The priority 2 and priority 3 programs can wait until another fiscal year. The Lighting Program is identified as a priority 2 program despite its large share of DSM impacts. This is due to the fact that there is less uncertainty regarding energy savings from lighting measures, especially when compared to custom measures.

7.1 Non-Residential Custom Program

The non-residential Custom Program includes a large variety of projects. In FY 2007/2008, seven different types of measures received public benefits incentives. Table 7-2 identifies these seven measure groups along with the claimed impacts.

Table 7-2: Non-Residential Custom Program Measure Group Characteristics

Measure	Number of Rebates	Summer Peak Reduction (kW)	Annual Reduction (kWh)	kW % of Total	kWh % of Total
Air Compressors	2	15.4	69,720	2%	2%
By Pass	1	18.8	148,351	3%	3%
Chiller	2	307.6	2,716,439	46%	60%
Lighting	13	241.5	915,202	36%	20%
Pump	1	40.0	350,400	6%	8%
Transformer	1	40.2	350,784	6%	8%
Total	20	663.4	4,550,896	100%	100%

Each of these measure groups represents very diverse measures. About one-half of the claimed savings for both energy and demand are from chillers. This is despite the fact that chillers represent only two of the 26 measures implemented under the Custom Program. Lighting is the second largest group of measures in terms of claimed savings with a share of 20% of the energy and 36% of the demand impact.

The estimates of energy impacts for the Custom Program are based on customer submitted documentation that includes project methodology and calculations. Invoices are also required to be submitted with each application. The rebate amount is based on the adjusted peak kW load reduction.

Option A of the IPMVP M&V Options identified in Table 2-1 is recommended to be followed. The methodology should consist of on-site verification of measure installation and review of the engineering calculations made for each measure installed.

The review of the program tracking database indicates that there were twenty custom projects. To achieve evaluation results that meet the statistical confidence of 90% +/- 10% will require a sample of sixteen projects. The projects will be grouped into measure types and sixteen projects will be randomly selected that approximate the overall distribution of energy impacts. Verification of installation of these measures will be done through on-site inspection of each sampled project site.

7.2 Lower Priority Non-Residential Program Evaluation

The Summit Blue Team does not recommend that impact evaluations be performed in this fiscal year for the remaining lower priority programs. The Lighting Program, if it maintains it's current

level of impact significance, should be evaluated next fiscal year. Whether impact evaluations should be held in the future for the remaining measures depends on whether they become a more important part of the energy savings portfolio. If such an evaluation were to take place, it is recommended that the simple Option A of the IPMVP M&V Options be followed for most of the measures. It appears that either deemed savings or engineering calculations are used in these three programs to estimate program impacts. Verification would likely be through on-site visits.

8 EVALUATION PLAN TIMING AND BUDGET

Evaluation efforts should begin immediately after receiving approval of these EM&V plans from RE. The goal is to have the evaluations completed by the end of February 2009. The total budget estimated by Summit Blue for this Phase of the project is $49,840. Table 8-1 provides details on the budget estimated for each program to be evaluated.

Table 8-1: Summit Blue's Proposed Evaluation Budget

			Residential New Construction			Residential HVAC			Residential Shade Tree		Non-Residential Custom				TOTAL	
Personnel	**Function**	**Rate**	**Additional Process Evaluation**	**Impact Evaluation**	**Final Report**	**Additional Process Evaluation**	**Impact Evaluation**	**Final Report**	**Impact Evaluation**	**Final Report**	**Additional Process Evaluation**	**Custom Measure Impact Evaluation**	**LivingWise Impact Evaluation**	**Final Report**	**Hours**	**Cost**
Kevin Cooney	Principal	$215	0	0	2	0	0	2	0	0	0	0	0	4	8	$1,720
Gary Cullen	Project Manager	$165	0	0	4	0	0	4	20	8	0	8	16	12	72	$11,880
Deborah Swarts	Engineer	$150	0	16	12	0	16	12	0	0	0	24	0	12	92	$13,800
Jackie Goss	Engineer	$120	0	16	12	0	16	12	0	0	0	44	0	12	112	$13,440
Katherine Johnson	Consultant	$125	8	0	4	8	0	4	0	0	16	0	0	8	48	$6,000
Admin	Admin	$60	0	0	4	0	0	4	4	2	0	0	0	4	18	$1,080
Total Hours			8	32	38	8	32	38	24	10	16	76	16	52	350	$47,920
Other Direct Costs																
Phone Surveys																$0
Metering Equipment												$120				$120
Travel, Food & Hotel				$300			$300		$300			$900				$1,800
	Total Labor		$1,000	$4,320	$5,070	$1,000	$4,320	$5,070	$3,540	$1,440	$2,000	$10,200	$2,640	$7,320		$47,920
	Total ODCs		$0	$300	$0	$0	$300	$0	$300	$0	$0	$1,020	$0	$0		$1,920
	Total Cost by Task		**$1,000**	**$4,620**	**$5,070**	**$1,000**	**$4,620**	**$5,070**	**$3,840**	**$1,440**	**$2,000**	**$11,220**	**$2,640**	**$7,320**		**$49,840**

APPENDIX A: ENERGY STAR SPECIFICATIONS

Residential Appliances

ENERGY STAR Qualified Clothes Washers

Clothes Washers Key Product Criteria

Equipment	Criteria
Clothes Washers	Minimum Modified Energy Factor (MEF) of 1.72 and a maximum Water Factor (WF) of 8.0.

The ENERGY STAR criteria for clothes washers changed on January 1, 2007. The new ENERGY STAR criteria require all qualified products to have a Modified Energy Factor (MEF) of 1.72 or greater, as well as a Water Factor (WF) of 8.0 or lower. MEF is an equation for Energy Factor that takes into account the amount of dryer energy used to remove the remaining moisture content in washed items.

Criteria/Product Type	Current Criteria Levels (as of January 1, 2007)	July 1, 2009	January 1, 2011
ENERGY STAR top and front loading	MEF[1] >= 1.72 WF[2] <= 8.0	MEF >= 1.8 WF <= 7.5	MEF >= 2.0 WF <= 6.0

[1]MEF = modified energy factor

[2]WF = water factor (gallons per cycle per cubic foot)

ENERGY STAR Qualified Clothes Washer Eligibility

Only front and top loader clothes washers with capacities of greater than 1.6 ft^3 are eligible to earn the ENERGY STAR.

Energy Performance Metrics

Energy Factor (EF) is the previous energy performance metric for clothes washers. It is the quotient of the capacity of the clothes container, C, divided by the sum of the machine electrical energy for the mechanical action of a cycle, M, and the water heating energy required for a cycle, E. The equation is shown here:

$$EF = \frac{C}{M + E}$$

The water heating energy may be from a gas or electric water heater. The units are cubic feet per kWh per cycle, ft3/kWh/cycle. The higher the value, the more efficient the clothes washer is.

Modified Energy Factor, MEF, is the energy performance metric for ENERGY STAR qualified clothes washers and all clothes washers as of January 1, 2004.

This metric has the same units as the energy factor (EF): ft3/kWh/cycle. MEF is the quotient of the capacity of the clothes container, C, divided by the total clothes washer energy consumption per cycle, with such energy consumption expressed as the sum of the machine electrical energy consumption, M, the hot water energy consumption, E, and the energy required for removal of the remaining moisture in the wash load, D. The higher the value, the more efficient the clothes washer is. The equation is shown below:

$$MEF = \frac{C}{M + E + D}$$

Water Factor, WF, is the present water performance metric that allows the comparison of clothes washer water consumption independent of clothes washer capacity. Manufacturers must submit their water consumption factors with their ENERGY STAR qualified clothes washers.

WF is the quotient of the total weighted per-cycle water consumption, Q, divided by the capacity of the clothes washer, C. The lower the value, the more water efficient the clothes washer is. The equation is shown below:

$$WF = \frac{Q}{C}$$

The federal EnergyGuide label on clothes washers shows annual energy consumption and cost. These figures use the energy factor, average cycles per year, and the average cost of energy to make the energy and cost estimates. The Energy Factor, Modified Energy Factor, or Water Factor may not appear on the EnergyGuide label.

Dishwashers Key Product Criteria

Equipment	Criteria
Dishwashers	At least 41% more energy efficient than minimum federal government standards

Product Type	Federal Standard Energy Factor	ENERGY STAR Energy Factor
Standard (>= 8 place settings + six serving pieces)	>= 0.46	>= 0.65
Compact (< 8 place settings + six serving pieces)	>= 0.62	>= 0.88

The current ENERGY STAR criteria for dishwashers became effective January 1, 2007. This criterion is at least 41% above the federal standard and applies only to models manufactured after January 1, 2007.

Energy Performance Metric

Energy Factor (EF) is the dishwasher energy performance metric. EF is expressed in cycles per kWh and is the reciprocal of the sum of the machine electrical energy per cycle, M, plus the water heating energy consumption per cycle, W.

$$EF = \frac{1}{M + W}$$

This equation may vary based on dishwasher features such as water heating boosters or truncated cycles. The greater the EF, the more efficient the dishwasher is. The EF is the energy performance metric of both the federal standard and the ENERGY STAR qualified dishwasher program. The federal EnergyGuide label on dishwashers shows the annual energy consumption and cost. These figures use the energy factor, average cycles per year, and the average cost of energy to make the energy and cost estimates. The EF may not appear on the EnergyGuide label.

Refrigerators & Freezers Key Product Criteria

Equipment	Volume	Criteria
Full Size Refrigerators	7.75 cubic feet or greater	At least 20% more energy efficient than the minimum federal government standard (NAECA).
Full Size Freezers	7.75 cubic feet or greater	At least 10% more energy efficient than the minimum federal government standard (NAECA).
Compact Refrigerators and Freezers	Less than 7.75 cubic feet and 36 inches or less in height	At least 20% more energy efficient than the minimum federal government standard (NAECA).

On April 28, 2008, the ENERGY STAR criteria changed for all full-size refrigerators. All refrigerators greater than 7.75 cubic feet must be at least 20% more efficient than the federal standard. The ENERGY STAR criteria for full-sized freezers and compact refrigerators and freezers did not change at this time.

On January 1, 2004, the ENERGY STAR criteria for refrigerators changed to require all full-size models to be at least 15% above the minimum federal standard to qualify for ENERGY STAR. Please note, the ENERGY STAR criteria for full-sized freezers and compact refrigerators and freezers did not change at this time.

On January 1, 2003, the ENERGY STAR criteria for refrigerators expanded to include all sizes and configurations of refrigerators and freezers.

- All refrigerators and freezers 7.75 cubic feet or greater in volume must be at least 10% above the minimum federal standard to qualify for ENERGY STAR.

- All refrigerators and freezers less than 7.75 cubic feet in volume and 36 inches or less in height had to be at least 20% above the minimum federal standard to qualify for ENERGY STAR.

This expansion allowed the qualification of the previously ineligible products in the following categories:

- Chest freezers
- Upright freezers
- Manual defrost freezers and refrigerators
- Partial automatic defrost refrigerators
- Single door refrigerators
- Compact refrigerators and freezers

Federal Standards (NAECA)

The National Appliance Energy Conservation Act (NAECA) dictates minimum standards for energy consumption in refrigerators and freezers. The standard varies depending on the size and configuration of the refrigerator or freezer.

Refrigerators and freezers are categorized by:

- Configuration (side-by-side, top freezer, bottom freezer, single door refrigerator and freezer, single door refrigerator only, chest freezer, and upright freezer)
- Automatic or manual defrost
- For refrigerators, whether or not they have through-the-door ice service

Adjusted Volume (AV) for refrigerators is calculated as follows: AV = (Fresh Volume) + 1.63 x (Freezer Volume).

For freezers, the adjustment factor is 1.73 so the calculation is: AV = 1.73 x Freezer Volume.

Fresh Volume is the total volume of the main refrigerator compartment.

Freezer Volume is the total volume of the freezer compartment.

Calculate the Federal Standard (NAECA) and the ENERGY STAR criteria for refrigerators and freezers.

One may still find refrigerator and freezer models designated as ENERGY STAR at retail that met the previous ENERGY STAR criteria for an extended period of time. If one has recently purchased one of these models, even though these models do not meet the current ENERGY STAR criteria for refrigerators and freezers, one can be confident that the product is highly efficient.

In addition, some of the ENERGY STAR qualified refrigerators and freezers displayed on the Web site were recently introduced into the market and may not be available for purchase in certain areas.

Central Air Conditioners

New ENERGY STAR Specification to Take Effect January 1, 2009

On January 1, 2009, ENERGY STAR Tier 2 requirements for central air conditioners and air source heat pumps will take effect. The Tier 2 requirements are as follows:

Product Type	SEER	EER	HSPF
Split Systems	>=14.5	>=12	>=8.2
Single Package (including gas/electric package units)	>=14	>=11	>=8

Air-Source Heat Pumps and Central Air Conditioners Key Product Criteria

Equipment	Specification
Air-Source Heat Pumps	>= 8.2 HSPF/ >=14 SEER/ >=11.5 EER* for split systems >= 8.0 HSPF/ >=14 SEER/ >=11 EER* for single package equipment including gas/electric package units
Central Air Conditioners	>=14 SEER/ >=11.5 EER* for split systems >=14 SEER/ >=11 EER* for single package equipment including gas/electric package units

*Energy Efficiency Ratio

Additions to consider

Programmable Thermostats Key Product Criteria

Equipment	Specification
Programmable Thermostats	Shipped with a default energy saving program that is capable of maintaining two separate programs (to address the different comfort needs of weekdays and weekends) and four temperature settings or more for each day.

TVs

TVs, VCRs, & Combination Units Key ENERGY STAR Product Criteria

Equipment	Specification
DCR TVs with POD Slots	**Consume three watts or less when no POD is installed** **Consume 15 watts or less when a POD is installed**
Analog TV Monitors, Televisions, Digital TV Monitors, Component TV Units, VCRs*, TV/VCR Combination Units*, TV/DVD Combination Units*, VCR/DVD Combination Units*, and TV/VCR/DVD Combination Units*	**Consume one watt or less when switched off**

*Units with illuminated or backlit displays or other electronic status indicators may add an additional one watt to the existing one watt specification.